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West Virginia University
Agricultural Experiment Station
MORGANTOWN

AGRONOMY DEPARTMENT

Soybean Experiments

Soybeans Ready to Cut for Hay. Pods are Well Filled

BY

F. W. STEMPLE

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SUMMARY

1.—The Peking, Wilson, Virginia, Arlington, Roosevelt, and Jet are some of the best varieties for all purposes in West Virginia.

2.—Soybeans outyield cowpeas and are much more easily cured.

3.—Soybeans and Sudan grass and soybeans and millet when grown together are two combinations that give high yields of easily cured roughage.

4.—The amount of roughage produced on a small acreage can be increased by growing corn, rye, and soybeans, getting three crops in two years.

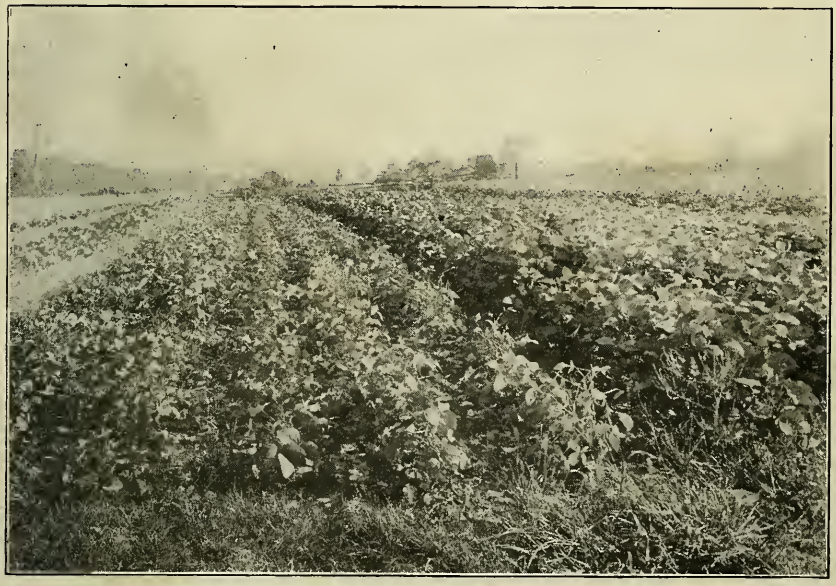
5.—Little difference in yield of hay is obtained by seeding solid vs. in rows.

6.—Earlier seedings gave best yields when time of planting was tested.

7.—Four pecks per acre drilled solid seems to be the maximum seeding that one can afford. Half this amount will be sufficient when drilled in rows 28 to 30 inches apart.

8.—The best time to cut soybeans for hay seems to be when pods are fairly well filled and the leaves are just barely beginning to turn.

9.—The results with lime indicate that soybeans do well on land too acid for clover.



Soybean Varieties on the W. Va. Experiment Station Farm.

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Soybean Experiments*

By F. W. STEMPLE

Soybeans are rapidly becoming a very important crop in West Virginia agriculture. In fact the statement that the soybean is "the West Virginia legume" is quite true. The clover acreage in this state is declining very rapidly because of inability on the part of our farmers to grow clover. Soybeans are not affected by many conditions unfavorable to clover and consequently they are being grown instead. From reports made by county agricultural agents the following very conservative estimate of soybean acreage in this state is given, from which some idea of the growth in popularity of the crop can be gained.

1916	3500 to 4000 Acres
1917	6000 to 10000 Acres
1918	12000 to 18000 Acres
1919	15000 to 22000 Acres

Various experiment stations report feeding tests and analyses which show that soybean hay may be used in dairy and other rations to take the place of high priced concentrates such as cottonseed meal, oil cake, and bran. These are considerations of no mean importance when all feeds are so expensive and hard to obtain.

Since soybeans belong to the legume family, and when properly inoculated bear numerous nodules on their roots,** a very large part or all of their nitrogen is obtained from the air through the agency of bacteria found in these root nodules. Farmers generally report good wheat crops after soybeans, which indicates the value of this crop in the rotation.

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*The work on soybeans from 1912-16 was done under direction of I. S. Cook and W. B. Kemp.

** There are several methods used for inoculation. The pure culture method is growing rapidly in popularity and this method can be highly recommended. The Government, to a limited amount, will furnish free inoculation. Write the U. S. Department of Agriculture, Bureau of Plant Industry, Soil Bacteriology Investigations, Washington, D. C., for particulars. All good seedsmen sell this material in any quantity desired.

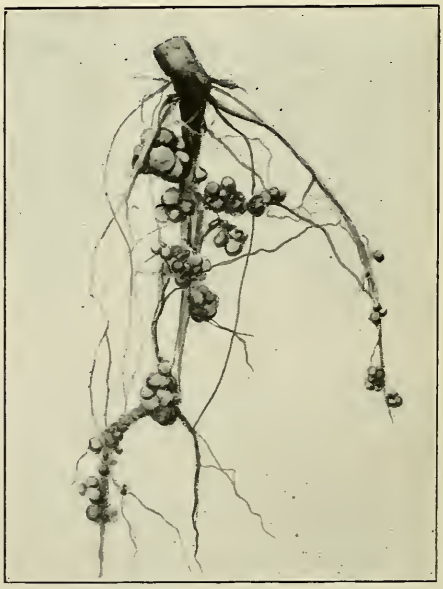
Soil Method of Inoculation is as follows: Spread seed for inoculation on a clean floor or table. Over each bushel of seed sprinkle about one quart of water in which a very small handful of dry glue has been dissolved (a bottle of liquid glue is as good but more expensive). Stir seed well, the object being to get every seed coated with a slight film of water. Then over this immediately sift soil from a field where a soybean crop from seed bearing inoculation has been grown. See that enough soil is used so that every seed will get a particle. About one quart of soil to a bushel of seed is sufficient. Spread and dry quickly. The object of the glue is to make the surface of the seed sticky as it dries so that minute particles of soil will stick. When dry, shovel seed and dirt all into sacks ready for sowing. This work must be done where direct sunlight will not strike the seed or the inoculated soil. Drill or sow and cover the seed when sun is not shining. This is the easiest and cleanest method of using inoculated soil and is just as effective as the old method of scattering 4 or 5 bushels of soil over the field and harrowing in.

Experiments in the production of this important crop were started at the West Virginia Experiment Station in 1912. Since then various tests have been started, the results of which are given in this bulletin.

VARIETIES

Possibly no other field crop has such wide variations in color, size, shape, and time required for maturity as has the soybean.

There are a number of things that determine varietal differences in soybeans, such as length of time to bloom and ripen; color of seed, germ, bloom; size, number, color, and persistence of leaves; size, color, shape and number of seeds; pubescence or hairyness of stem, leaves and pods; size, shape and color of pods; and quality, size and habit of growth of vines and stems. The following table describes, from a practical standpoint, some of the better known varieties studied at this Station, persistence of leaves, coarseness of stems, and other items named in table determining largely the quality of the plant.



Nitrogen is Supplied by Means of Bacteria Found in the Nodules on the Roots of the Plant.

TABLE I.—Descriptive Data on Soybean Varieties.*

Variety	Days to Maturity	Height in Inches	Color		Leaves		Habit of Stem	Quality of Stem
			Seed	Scar	Quantity	Persistence		
Wilson	110	34	Black	Black	Abundant	Good	Erect	Medium
Flat King	110	42	Black	Black	Abundant	Fair	Lodging	Coarse
Medium Black	117	31	Black	Black	Medium	Poor	Lodging	Medium
Fairchild	104	41	Black	Black	Medium	Fair	Lodging	Medium
Chernie	96	20	Black	Black	Abundant	Fair	Lodging	Fine
Flava	106	45	Black	Black	Abundant	Fair	Lodging	Coarse
Nutoll	107	38	Black	Black	Medium	Fair	Lodging	Medium
Auburn	110	32	Black	Black	Medium	Fair	Lodging	Medium
Cloud	115	50	Black	Black	Abundant	Fair	Twining	Fine
Edna	115	36	Black	Black	Medium	Fair	Lodging	Medium
Ogena	107	36	Black	Black	Medium	Fair	Suberect	Coarse
Shanghai	125	40	Black	Black	Abundant	Fair	Erect	Coarse
Shingtoa	105	31	Black	Black	Medium	Fair	Erect	Fine
Jet	110	34	Black	Black	Abundant	Fair	Erect	Fine
Myers	112	32	Black	Black	Abundant	Fair	Erect	Coarse
Ebony	104	36	Black	Black	Medium	Fair	Lodging	Medium
Black Beauty	112	42	Black	Black	Abundant	Fair	Erect	Medium
Peking	117	40	Black	Black	Abundant	Fair	Procumbent	Fine
Sable	117	39	Black	Black	Medium	Fair	Erect	Medium
Royal	117	54	Black	Black	Abundant	Fair	Suberect	Medium
Arlington	118	50	Black	Black	Medium	Fair	Procumbent	Fine
Kingston	110	36	Black	Black	Medium	Fair	Lodging	Medium
Pingzu	112	55	Black	Black	Medium	Fair	Procumbent	Medium
Kentucky	106	36	Yellow-Mottled	Yellow	Medium	Fair	Suberect	Coarse
Duggard	102	33	Yellow-Mottled	Yellow	Medium	Poor	Erect	Medium
Quebec	102	28	Yellow-Mottled	Brown	Medium	Poor	Erect	Medium
Habara	102	36	Yellow-Mottled	Yellow	Medium	Poor	Suberect	Medium

* These data were collected by John I. Allman in 1916 as a thesis requirement.

TABLE I. (Cont'd)—Descriptive Data on Soybean Varieties.*

Variety	Days to Maturity	Height in Inches	Color		Leaves		Habit of Stem	Quality of Stem
			Seed	Scar	Quantity	Persistence		
Mongol	112	43	Yellow	Brown	Medium	Fair	Erect	Coarse
Buckshot	115	42	Yellow-Mottled	Black	Medium	Fair	Lodging	Coarse
Taha	119	48	Black-Mottled	Black	Medium	Fair	Lodging	Coarse
Black Eyebrow	103	36	Black-Mottled	Black	Medium	Fair	Lodging	Medium
Green Tashing	103	30	Green-Mottled	Black	Medium	Fair	Lodging	Fine
Amherst	108	39	Green-Mottled	Black	Medium	Fair	Lodging	Medium
Meyer	115	36	Brown-Mottled	Brown	Medium	Fair	Suberect	Coarse
Early Virginia	103	34	Yellow-Brown	Brown	Medium	Fair	Suberect	Coarse
Ito San	99	36	Yellow	Yellow	Medium	Fair	Erect	Medium
Elton	103	34	Yellow	Yellow	Medium	Fair	Suberect	Medium
Chestnut	103	34	Yellow	Yellow	Medium	Fair	Erect	Coarse
Shingto	104	36	Yellow	Yellow	Medium	Fair	Suberect	Medium
Acme	119	41	Yellow & Black	Brown	Medium	Fair	Suberect	Coarse
Chiquita	125	45	Yellow&Brown	Brown	Abundant	Fair	Lodging	Medium
Hope	120	45	Olive	Brown	Medium	Fair	Lodging	Coarse
Mam'th Yellow	130	36	Yellow	Yellow	Medium	Fair	Suberect	Coarse
Manchu	100	30	Yellow	Black	Medium	Fair	Lodging	Coarse
Manchuria	103	32	Yellow	Brown	Medium	Fair	Suberect	Coarse
Sonoma	115	36	Yellow	Dark	Medium	Fair	Suberect	Coarse
Swan	115	36	Brown	Brown	Medium	Fair	Suberect	Coarse
O'Kute	108	36	Olive-Mottled	Yellow	Abundant	Good	Erect	Medium
Barchet	108	36	Olive	Brown	Medium	Fair	Erect	Coarse
Yoko	125	42	Yellow & Brown	Brown	Medium	Fair	Suberect	Coarse
Haberlandt	112	39	Yellow & Brown	Brown	Medium	Fair	Suberect	Coarse
Brooks	103	50	Yellow	Yellow	Medium	Fair	Procumbent	Medium
Hinangdon	125	60	Yellow	Brown	Abundant	Fair	Procumbent	Medium
Manhattan	103	32	Yellow	Yellow	Medium	Fair	Lodging	Medium

TABLE I. (Cont'd)—Descriptive Data on Soybean Varieties.*

Variety	Days to Maturity	Height in Inches	Color		Leaves		Habit of Stem	Quality of Stem
			Seed	Scar	Quantity	Persistence		
Baird	106	48	Brown	Brown	Abundant	Fair	Procumbent	Medium
Brownie			Brown	Brown	Medium	Fair	Procumbent	Coarse
Eda	103	31	Brown	Black	Abundant	Fair	Lodging	Medium
Ogema	106	33	Olive	Black	Medium	Fair	Lodging	Medium
Brown	103	35	Brown	Brown	Medium	Fair	Lodging	Medium
Virginia	112	72	Brown	Brown	Abundant	Fair	Procumbent	Medium
Merko	103	48	Brown	Brown	Abundant	Fair	Procumbent	Medium
Medium Green	112	36	Green	Black	Medium	Fair	Erect	Coarse
Morse	115	40	Olive	Gray	Medium	Fair	Suberect	Coarse
Early Green	115	32	Green	Black	Medium	Fair	Suberect	Coarse
Yosho	113	36	Green	Dark	Medium	Fair	Suberect	Coarse
Mikado	115	32	Yellow	Brown	Medium	Fair	Suberect	Medium
Roosevelt	109	38	Yellow	Brown	Medium	Fair	Erect	Medium
Medium Yellow	113	38	Yellow	Brown	Medium	Fair	Erect	Medium
Isurunoko	103	29	Yellow	Yellow	Medium	Fair	Erect	Coarse
Oyachi	103	24	Yellow	Yellow	Medium	Fair	Erect	Coarse
Okosoya	103	16	Yellow	Black	Medium	Poor	Erect	Coarse
Shirotairyu	103	24	Yellow	Brown	Medium	Poor	Erect	Coarse
Tashing	103	40	Green	Black	Medium	Fair	Erect	Medium
Sherwood	116	50	Olive	Brown	Medium	Fair	Erect	Medium
Columbia	125	40	Green	Brown	Medium	Fair	Erect	Medium
Akasoya	106	21	Yellow	Black	Medium	Poor	Erect	Medium
Nemo	114	32	Olive	Olive	Medium	Fair	Erect	Coarse

For nearly all parts of West Virginia any of the soybeans that will mature in 110 days can be safely planted. That would mean that soys planted before June 15 would mature on or before October 1st, at which date the danger from injurious frosts would amount to little or nothing. For hay the finer stemmed and taller varieties are preferable since they will make a better quality of hay which can be fed with the least amount of waste.

A number of the more common and, in many respects, better varieties have been tested for seed and hay. Table II gives the results of the tests for seed production.

TABLE II.—Soybean Variety Test for Seed Production.

Variety	Yield in Bushels per Acre						Average
	1912	1913	1914	1915	1916	1917	
Hollybrook	22	18.1	18.1	14.55			18.18
Morse		21.4	21.2	18.72		7.20	17.13
Wilson		23.8	19.9	13.87	7.37	15.11	17.01
Jet			15.0	18.65			16.82
Wilson II	*			24.13	8.56	17.63	16.77
Manchu			15.6	21.2	7.15	21.21	16.29
Peking		23.8	17.4	19.48	7.08	13.20	16.19
Arlington		19.0	14.7	17.7	7.37	11.86	16.13
Medium Green	22.2	*9.4					15.8
Virginia			17.4	21.87	8.55	14.01	15.46
Brown	24.2	*12.6	17.7	18.82	8.7	9.83	15.31
Ito San			20.4	18.45	5.6	16.50	15.26
Auburn			15.8	22.37	6.78	12.94	14.47
Roosevelt			19.6	17.5	5.67	14.52	14.32
Wilson 89				19.08	7.08	16.57	14.14
Meyer		16.9	17.5	14.7	8.55	10.44	13.62
Sable			15.8	19.8	7.81	10.86	13.57
Chernie			18.7	17.47	6.78	10.06	12.75
Haberlandt						8.42	8.42

* Shattered badly.

In the soybean seed test, while the Hollybrook stands first in the general average, examination of the above table will show that for 3 years it fell behind a number of other varieties each year. The Morse and Wilson are close rivals in general average, but in 1917 the yield of Wilson was nearly double that of the Morse, which was not tested in the bad year 1916, a thing that helps to bring its average high. In general, the Wilson is the best yielder tested at this Station. The Peking is smaller seeded consequently a bushel of the beans will seed

more land than a bushel of any of the other varieties, a consideration worth remembering if one is growing seed for his own use.

TABLE III.—Soybean and Cowpea Variety Test for Hay.

Variety	Yield in Tons per Acre						Average
	1912	1914	1915	1916	1917	1918	
Soybeans:							
Peking		2.11	2.08	2.40	3.31	2.71	2.52
Morse		2.42	2.58				2.50
Haberlandt					2.53	3.06	2.32
Wilson		1.61	2.16	2.19	2.40	3.12	2.29
Virginia		1.32	2.27	2.25	2.48	3.06	2.28
Arlington		1.79	2.00	2.52	2.24	2.80	2.27
Jet		2.08	1.86				2.19
Sable		2.01	2.27	2.28	2.17		2.18
Mikado		2.41	1.92				2.16
Meyer		2.08	2.19				2.13
Roosevelt		2.61	1.88	2.16	1.77	1.67	2.02
Brown	1.96	1.99	1.75				1.90
Hollybrook	1.72	1.89	1.87				1.83
Medium Green	1.72						1.72
Chernie		1.39	1.95				1.67
Auburn		1.19	2.11				1.65
Ito San		1.31	1.65				1.48
Manchu		1.01	1.61				1.31
Cowpeas:							
Brabham					1.64	2.58	2.11
Groit					1.52	2.20	1.86
Whippoorwill				1.08	1.65	2.63	1.78
Wonderful					1.76		1.76
Clay					.97	2.50	1.73
New Era				.93	1.72	2.76	1.47
Iron				.95	1.88		1.41
Average yield all soybeans last three years				2.30	2.41	2.73	2.48
Average yield all cowpeas last three years				.99	1.59	2.53	1.70

Taking into consideration what is shown in Tables I, II, and III, the best varieties grown at this Station are the Peking, Wilson, Virginia, Arlington, Roosevelt and Jet. All are high seed and hay yielders and all have from medium to fine stems, insuring little or no waste in feeding.

SOYBEANS VS. COWPEAS FOR HAY

The results of experiments at this Station have brought out some interesting comparisons between soybeans and cowpeas for hay. The following table shows these differences quite conclusively.

TABLE IV.—Comparison of Soybeans and Cowpeas for Hay

	Date Cut	Date Hauled	Percent of Moisture When Hauled	Average Yield Dry Hay (Tons)
Soybeans, 1917	Sept. 9	Sept. 16	35.19	2.41
Cowpeas, 1917	Sept. 9	Sept. 16	73.94	1.59
Average of all varieties of soys, 1916-18 inclusive				2.48
Average of all varieties of cowpeas, 1916-18 inclusive				1.70
Difference in favor of soys, 1916-18 inclusive				.78
Difference in favor of soys, 1917				.82

In 1917 the soybeans and cowpeas were cut at the same time and all received exactly the same kind of treatment, yet when the time came to haul in the hay the cowpea hay still contained 73.94% of water. This indicates how much harder they are to cure than the soybeans. When their yield is compared with that of the soybeans again their inferiority is shown in the fact that they yield about a ton less of dry hay than do the soybeans. Still further, it is found almost impossible to grow cowpeas to maturity in the vicinity of Morgantown. For all parts of West Virginia the soybean seems a better crop to grow than the cowpea.

SOYBEANS AND OTHER PLANTS GROWN IN COMBINATION FOR HAY

Soybeans are sometimes recommended as a companion crop for corn for the production of ensilage. Unfortunately only one year's data have been collected on this and other combinations given in Table V. The results, however, are rather indicative of what one might expect and are, therefore, given. Other combinations have been tried not only to determine methods of increasing the production of valuable roughages but also to see whether or not a combination can be grown that will make the curing of the hay easier and better. Following are the results of these tests.

TABLE V.—Soybeans and Other Plants Grown in Combination for Hay

Crop Combination	Yield in Tons per Acre		
	1915	1918	Average
Corn alone (ensilage)	8.97		8.97*
Corn and Soys (ensilage)	10.16		10.16
Soys alone (hay)	3.11	2.68	2.89
Sudan alone (hay)	3.10	1.92	2.51
Sudan and Soys (hay)	3.32	3.12	3.22
Sorghum alone (hay)		6.52	6.52
Sorghum and Soys (hay)		5.06	5.06
Millet alone (hay)		3.90	3.90
Millet and Soys (hay)		3.86	3.86

Rate of seeding alone: Soys, 6 pks.; Sudan, 30 lbs.; Sorghum, 60 lbs.; Millet 30 lbs.
Rate of seeding in combination: Soys, 5 pks.; 1/2 of above rate for others.
* Ensilage weighed green, hay weighed dry.

It was found that soybeans and Sudan grass mixed made a very fine quality of hay, easily cured and easily handled. When fed to the stock it was eaten clean. Sorghum and soybeans made a very coarse hay, very little better than sorghum alone, hard to cure and hard to handle, and did not therefore, gain much favor. In this mixture the soybeans did not make much of a showing. The soybeans and millet made the best appearance while growing. The hay cured easily, was fine in quality, and seemed to be highly relished by live stock.

In all of the hay combinations the yields were better than for soys alone, and the hay was much more easily cured. However, one needs to keep in mind that the combination hay is not as high in meat- and milk-producing quality as the pure soybean hay and that if this sort of hay is to be used in combination with ensilage for wintering cattle in West Virginia that some cottonseed meal or other high-protein concentrate will probably need to be used to get best results.

In 1916 another combination was tried which is also indicative of the possibilities of combining soybeans with other crops to increase the amount of roughage on some of the West Virginia farms having a limited acreage of tillable land and a large acreage of pasture land. On such farms the problem of wintering all the cattle that the pasture will carry is a big one. The following table will prove interesting to those so situated.

TABLE VI.—Special Hay Test with Soybeans, Sudan Grass, and Rye (1916)

Spring Planted Crop	Planted	Acre Yields (average)		Total Hay
		Rye	Others	
Soybeans (Rye plowed under)	May 20		6123 lbs.	6123 lbs.
Soybeans (Rye cut for hay)	June 12	4396 lbs.	4191 lbs.	8587 lbs.
Sudan Grass (Rye plowed under)	May 20		6892 lbs.	6892 lbs.

By using a system of corn one year, seeded at last cultivation to rye which is harvested the following spring for hay before seeding soybeans, 3 crops can be obtained in two years. The data indicate that such a system is possible. However, the yield of soybean hay is considerably reduced. In using a system like this special care should be taken that all manure is carefully saved and returned to the field and that nothing interferes in getting crops properly seeded.

SEEDING

Experiments were carried on relative to the method, rate, and time of seeding in 1918. The results of these tests are given in the tables which follow.

TABLE VII.—Comparison of Methods of Seeding for Hay (1918)

Method of Seeding	Stem	Yield in Pounds of Hay						
		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Average	Acre (Tons)
Sown in rows	Coarse	95	83	90	87	83	37.6	3.50
Sown solid	Fine	95	88	87	81	81	86.4	3.45

Row plots were sown in rows 30 inches apart at the rate of 3 pecks per acre. Other plots were sown solid at 6 pecks per acre. Rows were cultivated 3 times and were clean. All plots were seeded June 4; cut Sept. 9; and hauled Sept. 19.

The result of this test shows that very little difference in weight of hay was obtained when sown in rows and solid. But in all plots sown in rows the stems were much coarser than when seeded solid, causing more waste in feeding. On the other hand, when seed is selling at $6.50 per bushel $3.25 is saved by seeding in rows. But when seeded in rows there has to be some cultivation, an item of no little consideration. However, on ground that is inclined to get weedy it is desirable that soybeans be planted in such a way that they can be cultivated.

TABLE VIII.—Time and Rate of Seeding as Affecting Yield *

Rate of Seeding	Time of Seeding			Ave. Yield in Tons per acre for all Dates
	June 1	June 19	July 3	
3 pecks per acre	3.22	1.67	.88	1.92
4 pecks per acre	3.42	1.94	.90	2.09
5 pecks per acre	3.44	2.01	.93	2.13
6 pecks per acre	3.34	2.08	1.06	2.16
7 pecks per acre	3.38	2.10	1.06	2.18
8 pecks per acre	3.53	2.01	1.22	2.25
Average of all rates	3.39	1.97	1.01	2.12
Time of cutting	9/27	9/30	10/15	
Condition at cutting	Leaves falling little	Leaves falling little	Leaves falling little	

* Number of repetitions for each rate for each date, 6; totaling 18 repetitions for each rate and 36 for each date. At time of cutting each seeding the leaves were falling but little.

In the tests of time of seeding the best yields in all cases were obtained from the earlier seedings. Averaging the yields for all dates for each of the different rates in the tests of rate of seeding it is seen that there was a gradual increase in the yield for each rate up to 8 pecks per acre but this increase is so slight that evidently no one can afford to use the higher rates. The thicker the seed was sown the finer were the stems, making up to a certain extent the extra cost of seeding in quality of hay. The results indicate that about 4 pecks per acre seeded as early as possible is best.

TIME TO CUT SOYBEAN HAY

Various agricultural writers have given opinions as to the best time to cut soybeans for hay. To determine this point more accurately some investigations were made in 1916. The results of these are given in Tables IX, X, and XI.

TABLE IX.—Time to Cut Soybean Hay.

No	Time of Harvesting	Maturity of Plants	Weight per Row (Pounds green)				Tons per Acre	
			Row 1	Row 2	Row 3	Total	Green	Dry Matter
1	Aug. 14	In bloom	47	31.5	33.	111.5	3.85	.65
2	Aug. 22	Pods formed	63.25	49.25	51.5	163.0	5.62	.98
3	Aug. 29	No pods filling	85.5	70.0	72.5	228.0	7.87	1.56
4	Sept. 4	Pods swelling	87.5	71.25	82.25	241.0	8.31	1.65
5	Sept. 12	Pods 2/3 full	95.25	72.	72.75	240.0	8.28	1.90
6	Sept. 19	Pods full, leaves turning	99.5	81.	84.0	264.5	9.13	2.10
7	Sept. 26	Leaves gone from 3 inches of stem	106.75	85.5	87.75	280.0	9.66	2.52
8	Oct. 3	3/4 leaves ripe, 1/3 pods ripe	78.5	73.5	77.5	229.5	7.92	2.27
9	Oct. 10	9/10 leaves and pods ripe	63.0	49.	49.0	161.0	5.55	

The yield of both green hay and dry matter increased up until Sept. 26 when some of the leaves had already fallen from the base of the stem. To get a better idea of the condition at these various cuttings, chemical analyses were made with results shown in Tables X and XI. Table X shows that the protein yield per plot gradually increased up to No. 6; that all other food constituents increased up to No. 7; and from there on the yield of all began to fall off. In Table XI some interesting figures are given relative to the composition of the plant through its various stages of growth.

The results of these investigations indicate that when the pods are fairly well filled out that the highest yield of green hay, dry matter, and protein is obtained. At that point the hay was much more palatable than at any following one, fibre content increasing from cutting to cutting, and fully as palatable as at any previous stage. As the hay approaches maturity its moisture content gets less and it is, therefore, more easily cured. Consequently the results seem to indicate that the best time to cut soybeans for hay is when pods are fairly well filled and the leaves are just barely beginning to turn.

TABLE X.—Soybean Hay Yield and Analysis at Different Stages of Cutting.

No.	Date	Stage	Field Wt. in Pounds	Total Yield in Pounds of					
				Dry Matter	Protein	Fat	Carbohydrates	Fiber	Ash
1	8/14/16		111.5	18.90	4.26	.34	7.56	5.55	1.17
2	8/22/16	All pods formed; none beginning to fill	163.0	28.56	6.48	.58	10.95	8.89	1.67
3	8/29/16	No pods filling	228.0	45.42	9.03	.87	19.46	13.66	2.42
4	9/ 4/16		241.0	47.98	9.78	1.28	19.93	14.74	2.25
5	9/12/16	Pods two-thirds full	240.0	55.20	11.36	2.51	22.82	15.81	2.69
6	9/19/16	Pods full, leaves beginning to ripen	264.5	60.86	12.66	3.44	24.84	17.29	2.86
7	9/26/16	First pods beginning to turn; leaves lost at base about 3 inches	280.0	73.17	11.96	5.45	32.62	19.82	3.30
8	10/ 3/16	3/4 of leaves brown; 1/3 of pods brown	229.5	65.80	12.01	5.06	27.63	18.08	3.00

TABLE XI.—Soybean Hay Analysis at Different Stages of Cutting.

(Percentage Composition)

No.	Moisture		Dry Matter		Protein		Fat		Carbohydrate		Fibre		Ash	
	A. D.	F. B.	A. D.	F. B.	A. D.	F. B.	A. D.	F. B.	A. D.	F. B.	A. D.	F. B.	A. D.	F. B.
1	7.39	83.05	92.61	16.95	20.90	3.83	1.68	.31	37.06	6.78	27.22	4.98	5.75	1.05
2	7.58	82.48	92.42	17.52	20.97	3.98	1.87	.35	35.42	6.72	28.76	5.45	5.40	1.02
3	7.60	80.08	92.40	19.92	18.37	3.96	1.76	.38	39.55	8.53	27.79	5.99	4.43	1.06
4	7.58	80.09	92.42	19.91	18.84	4.06	2.47	.53	38.37	8.27	28.40	6.11	4.34	.94
5	7.98	77.00	92.02	23.00	18.94	4.73	4.19	1.05	38.05	9.51	26.36	6.59	4.48	1.12
6	7.92	76.90	92.08	23.10	19.08	4.79	5.18	1.30	37.46	9.39	26.05	6.54	4.31	1.08
7	8.44	73.87	91.56	26.13	14.97	4.27	6.82	1.95	40.84	11.65	24.80	7.08	4.13	1.18
8	8.62	71.32	91.38	28.68	16.70	5.24	7.03	2.21	38.39	12.04	25.10	7.88	4.16	1.31
9	8.65	*	91.35	*	17.28		7.16		38.35		24.60		3.96	

F. B. = Field Basis.
A. D. = Air Dry.

* Sample selected for analysis was not weighed in field and as it lost considerable moisture before first weighing was made in the laboratory, analyses could not be calculated to a field basis.

IMMEDIATE EFFECT OF LIME ON SOYBEAN YIELD

That soybeans often do well on land that will not grow clover has been recognized by many growers. In some of the fertility work carried on by this Station some rather interesting data have been obtained regarding the immediate effect of lime on soybean hay production. The following table gives these results:

TABLE XII.—Immediate Effect of Lime on Soybeans for Hay

Treatment	Yield of Hay per Acre (Pounds)		
	Morgantown, 1916*	Huntington, 1918**	Average
Limed	3489	4477 †	3983
Unlimed	2929	5296 †	4113

*Average of 19 plots each.
**Average of 22 plots each.
†Soil of unlimed section considerably higher in fertility than that of limed section.

Each of the plots in both tests represented a different fertilizer treatment, yet the results for each plot showed that practically the same proportionate results were obtained for lime and no lime as in the average results. These results seem to indicate that only as lime in its long time effect on the general fertility of the soil increases yields of all crops will it have much effect on soybeans. In other words, the table seems to indicate that soybeans were not much affected by the immediate application of lime, the lime in both places having been put on a short time previous to seeding the soybeans. In the Huntington experiments immediate results were seen on clover. In this experiment, also, there seemed to be some difference in the color of soybean leaves, the limed plots being darker.

The results with lime indicate that soybeans will grow on soil too acid for clover.